STATEMENT OF OBJECTIVE(S)

Objective(s): The Polymer Branch (AFRL/MLBP) of the Air Force Research Laboratory, Materials and Manufacturing Directorate is currently focusing on advanced non-linear optical (NLO) materials research in the following areas: (i) laser hardening, (ii) optical microfabrication for microelectromechanical systems (MEMS) and data storage, (iii) confocal microscopy for aircraft corrosion detection, (iv) bulk curing for composite repair, and (v) rapid IR prototyping.

Description of Work: In support of the objectives presented above, the Polymer Branch requires the contractor to perform multi-photon evaluations on a suite of twenty (20) Air Force chromophores to be provided by AFRL/MLBP, and the contractor shall use several of the provided Air Force chromophores to fabricate two 3-D microfabricated structures to demonstrate photonic crystal circuitry fabrication.

Multi-photon non-linear optical properties represent an emerging technology with potential for laser hardening (ref. 1) and other AF applications. The Polymer Brach has synthesized one of the most comprehensive families of NLO chromophores available. These chromophores are currently being developed and tested for AF and commercial uses in two-photon absorption applications. The multi-photon tests to be accomplished will provide evaluation of these materials for structure/property studies of multi-photonic properties as a function of molecular structure thereby, providing a means to evaluation optimum structure for improve multi-photon properties. The contractor shall evaluate the NLO properties of 20 various organic model compounds and polymers provided by AFRL/MLBP and correlate the results in the context of defined or promising applications.

Characterization techniques will be determined by the contractor to yield a reproducible multi-photon properties database for the AF chromophores evaluated. The organic compounds, polymers and optically transparent composite materials shall be evaluated for the potential applications of laser hardening, and other potential AF applications. Appropriate processing conditions shall be determined to prepare the samples into a suitable form for the necessary NLO characterization experiment. The following techniques for the characterization of materials shall be included, but not limited to, UV and visible solution spectroscopy, Degenerate Four Wave Mixing, and Nonlinear Transmission, Degenerate White-Light Continuum, Multi-Photon Absorption to be run on each sample, or as designated by government POC. All twenty samples shall be measured by for multi-photon properties; additional characterizations will be done as needed. The specific characterization technique for the Degenerate White Light Continuum Measurements will be accomplished by the contractor using a Ti-Sapphire femto-second laser across wavelengths of 550-1100 nm, with a pulse width of 150fs, 800nm light source, power of 1mJoule, reproducibility of $\pm$ 15%, with a continuum source of deuterated heavy water using photoinduced spectroscopy.

In the case of multi-photon-cross section measurements, separate experiments are to be performed with each AF chromophore sample supplied by AFRL/MLBP. After characterization of each compound, the contractor shall furnish the government with complete analysis results including a 1-page letter report and copies of any measurement curves, which are generated. The two 3-D photonic crystal circuits shall also be provided to AFRL/MLBP upon completion. The contractor shall also provide a final report on conclusion of the technical effort, which summarizes all characterization work with any conclusions and recommendations noted. The government will furnish all material samples for characterization to the contractor. Material samples do not need to be returned. A total of 20 samples will be submitted for nonlinear optical multi-photon properties measurement.